

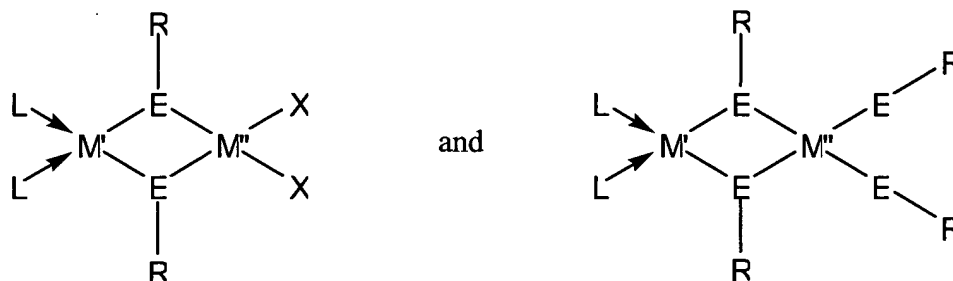
Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (canceled)

2. (currently amended) A single source precursor ~~according to claim 1,~~ for the deposition of ternary chalcopyrite materials, said single source precursor having a structural formula selected from the group consisting of



wherein L is a Lewis base that is coordinated to M' via a dative bond, M' is a Group I-B atom, M'' is a Group III-A atom, E is a Group VI-A atom, X is a Group VII-A atom, and each R is individually selected from the group consisting of alkyl, aryl, vinyl, perfluoro alkyl, perfluoro aryl, silane, and carbamato groups, said single source precursor excluding

[{P(C₆H₅)₃}₂Cu(S-C₂H₅)₂In(S-C₂H₅)₂],

[{P(C₆H₅)₃}₂Cu(Se-C₂H₅)₂In(Se-C₂H₅)₂],

[{P(C₆H₅)₃}₂Cu(S(*i*-C₄H₉))₂In(S(*i*-C₄H₉))₂],

[{P(C₆H₅)₃}₂Cu(Se(*i*-C₄H₉))₂In(Se(*i*-C₄H₉))₂],

[{P(C₆H₅)₃}₂Ag(Cl)(SC{O}CH₃)In(SC{O}CH₃)₂],

[{P(C₆H₅)₃}₂Ag(Cl)(SC{O}C₆H₅)In(SC{O}C₆H₅)₂],

[{P(C₆H₅)₃}₂Ag(SC{O}CH₃)₂In(SC{O}CH₃)₂],

[{P(C₆H₅)₃}₂Ag(SC{O}C₆H₅)₂In(SC{O}C₆H₅)₂],

[{P(C₆H₅)₃}₂Cu(SC{O}C₆H₅)₂In(SC{O}C₆H₅)₂],

[{P(C₆H₅)₃}₂Cu(SC{O}C₆H₅)₂Ga(SC{O}C₆H₅)₂],

[{P(C₆H₅)₃}₂Ag(SC{O}C₆H₅)₂Ga(SC{O}C₆H₅)₂], and

[{P(C₆H₅)₃}₂Ag(SC{O}CH₃)₂Ga(SC{O}CH₃)₂].

3. (original) A single source precursor according to claim 2, said single source precursor being a liquid at room temperature.

4. (original) A single source precursor according to claim 3, said single source precursor being soluble in polar organic solvents and in non-polar organic solvents.

5. (original) A single source precursor according to claim 2, of the formula
 $[\{ \text{P}(\text{n-C}_4\text{H}_9)_3 \}_2 \text{Cu}(\text{Se-C}_6\text{H}_5)_2 \text{In}(\text{Se-C}_6\text{H}_5)_2]$.

6. (original) A single source precursor according to claim 2, of the formula
 $[\{ \text{P}(\text{n-C}_4\text{H}_9)_3 \}_2 \text{Ag}(\text{S-C}_2\text{H}_5)_2 \text{In}(\text{S-C}_2\text{H}_5)_2]$.

7. (original) A single source precursor according to claim 2, of the formula
 $[\{ \text{P}(\text{n-C}_4\text{H}_9)_3 \}_2 \text{Cu}(\text{S-C}_2\text{H}_5)_2 \text{In}(\text{S-C}_2\text{H}_5)_2]$.

8. (original) A single source precursor according to claim 2, of the formula
 $[\{ \text{P}(\text{n-C}_4\text{H}_9)_3 \}_2 \text{Cu}(\text{S-C}_3\text{H}_7)_2 \text{In}(\text{S-C}_3\text{H}_7)_2]$.

9. (original) A single source precursor according to claim 2, of the formula
 $[\{ \text{P}(\text{C}_6\text{H}_5)_3 \}_2 \text{Ag}(\text{S-CH}_3)_2 \text{In}(\text{S-CH}_3)_2]$.

10. (original) A single source precursor according to claim 2, said single source precursor being effective to yield a I-III-VI₂ ternary chalcopyrite material upon heating or pyrolysis of said single source precursor at a temperature less than about 500°C.

11. (original) A single source precursor according to claim 2, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of about 1.5 eV between a conduction band and a valence band thereof.

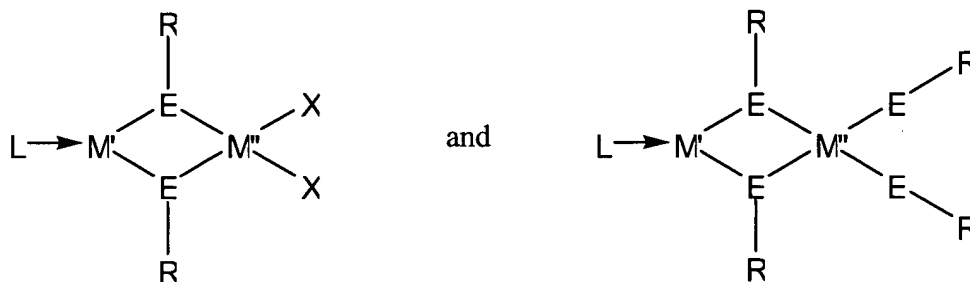
12. (original) A single source precursor according to claim 11, said ternary chalcopyrite material being CuInS₂.

13. (original) A single source precursor according to claim 2, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of about 2 eV between a conduction band and a valence band thereof.

14. (original) A single source precursor according to claim 13, said ternary chalcopyrite material being CuGaS₂.

15. (original) A single source precursor according to claim 2, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of 1.5-2 eV between a conduction band and a valence band thereof, said ternary chalcopyrite material being Cu(In:Ga)(S:Se)₂.

16. (currently amended) A single source precursor ~~according to claim 1, for the deposition of ternary chalcopyrite materials, said single source precursor~~ having a structural formula selected from the group consisting of



wherein L is a Lewis base that is coordinated to M' via a dative bond, M' is a Group I-B atom, M'' is a Group III-A atom, E is a Group VI-A atom, X is a Group VII-A atom, and each R is individually selected from the group consisting of alkyl, aryl, vinyl, perfluoro alkyl, perfluoro aryl, silane, and carbamate groups.

17. (original) A single source precursor according to claim 16, said single source precursor being effective to yield a I-III-VI₂ ternary chalcopyrite material upon heating or pyrolysis of said single source precursor at a temperature less than about 500°C.

18. (original) A single source precursor according to claim 16, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of about 1.5 eV between a conduction band and a valence band thereof.

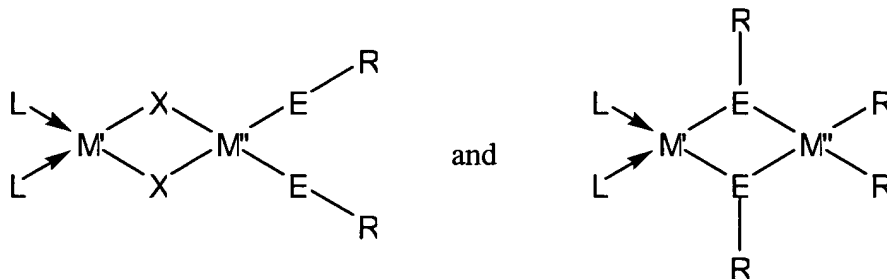
19. (original) A single source precursor according to claim 18, said ternary chalcopyrite material being CuInS_2 .

20. (original) A single source precursor according to claim 16, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of about 2 eV between a conduction band and a valence band thereof.

21. (original) A single source precursor according to claim 20, said ternary chalcopyrite material being CuGaS_2 .

22. (original) A single source precursor according to claim 16, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of 1.5-2 eV between a conduction band and a valence band thereof, said ternary chalcopyrite material being Cu(In:Ga)(S:Se)_2 .

23. (currently amended) A single source precursor ~~according to claim 1,~~ for the deposition of ternary chalcopyrite materials, said single source precursor having a structural formula selected from the group consisting of



wherein L is a Lewis base that is coordinated to M' via a dative bond, M' is a Group I-B atom, M'' is a Group III-A atom, E is a Group VI-A atom, X is a Group VII-A atom, and each R is individually selected from the group consisting of alkyl, aryl, vinyl, perfluoro alkyl, perfluoro aryl, silane, and carbamate groups.

24. (original) A single source precursor according to claim 23, said single source precursor being effective to yield a I-III-VI₂ ternary chalcopyrite material upon heating or pyrolysis of said single source precursor at a temperature less than about 500°C.

25. (original) A single source precursor according to claim 23, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of about 1.5 eV between a conduction band and a valence band thereof.

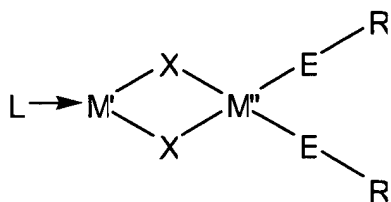
26. (original) A single source precursor according to claim 25, said ternary chalcopyrite material being CuInS₂.

27. (original) A single source precursor according to claim 23, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of about 2 eV between a conduction band and a valence band thereof.

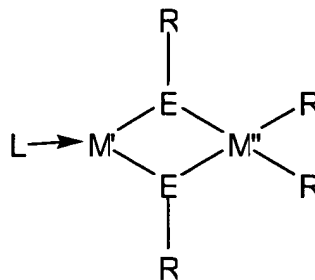
28. (currently amended) A single source precursor according to claim 27, said ternary chalcopyrite material being ~~CuGaS~~ CuGaS₂.

29. (original) A single source precursor according to claim 23, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of 1.5-2 eV between a conduction band and a valence band thereof, said ternary chalcopyrite material being Cu(In:Ga)(S:Se)₂.

30. (currently amended) A single source precursor ~~according to claim 1, for the~~
deposition of ternary chalcopyrite materials, said single source precursor having a structural
formula selected from the group consisting of



and



wherein L is a Lewis base that is coordinated to M' via a dative bond, M' is a Group I-B atom, M'' is a Group III-A atom, E is a Group VI-A atom, X is a Group VII-A atom, and each R is individually selected from the group consisting of alkyl, aryl, vinyl, perfluoro alkyl, perfluoro aryl, silane, and carbamate groups.

31. (original) A single source precursor according to claim 30, said single source precursor being effective to yield a I-III-VI₂ ternary chalcopyrite material upon heating or pyrolysis of said single source precursor at a temperature less than about 500°C.

32. (original) A single source precursor according to claim 30, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of about 1.5 eV between a conduction band and a valence band thereof.

33. (original) A single source precursor according to claim 32, said ternary chalcopyrite material being CuInS₂.

34. (original) A single source precursor according to claim 30, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of about 2-2.4 eV between a conduction band and a valence band thereof.

35. (original) A single source precursor according to claim 34, said ternary chalcopyrite material being CuGaS₂.

36. (original) A single source precursor according to claim 30, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of 1.5-2 eV between a conduction band and a valence band thereof, said ternary chalcopyrite material being Cu(In:Ga)(S:Se)₂.

37. (currently amended) A single source precursor according to claim 1, having three E-R groups for the deposition of ternary chalcopyrite materials, said single source precursor having the empirical formula [{L}_nM'(ER)_x(X)_y(R)_zM''], wherein x is 3, x+y+z=4, n is greater than or equal to 1, L is a Lewis base that is coordinated to M' via a dative bond, M' is a Group I-B atom,

M'' is a Group III-A atom, E is a Group VI-A atom, X is a Group VII-A atom, and each R is individually selected from the group consisting of alkyl, aryl, vinyl, perfluoro alkyl, perfluoro aryl, silane, and carbamato groups, said single source precursor excluding

[{P(C₆H₅)₃]₂Cu(S-C₂H₅)₂In(S-C₂H₅)₂],
[{P(C₆H₅)₃]₂Cu(Se-C₂H₅)₂In(Se-C₂H₅)₂],
[{P(C₆H₅)₃]₂Cu(S(*i*-C₄H₉))₂In(S(*i*-C₄H₉))₂],
[{P(C₆H₅)₃]₂Cu(Se(*i*-C₄H₉))₂In(Se(*i*-C₄H₉))₂],
[{P(C₆H₅)₃]₂Ag(Cl)(SC{O}CH₃)In(SC{O}CH₃)₂],
[{P(C₆H₅)₃]₂Ag(Cl)(SC{O}C₆H₅)In(SC{O}C₆H₅)₂],
[{P(C₆H₅)₃]₂Ag(SC{O}CH₃)₂In(SC{O}CH₃)₂],
[{P(C₆H₅)₃]₂Ag(SC{O}C₆H₅)₂In(SC{O}C₆H₅)₂],
[{P(C₆H₅)₃]₂Cu(SC{O}C₆H₅)₂In(SC{O}C₆H₅)₂],
[{P(C₆H₅)₃]₂Cu(SC{O}C₆H₅)₂Ga(SC{O}C₆H₅)₂],
[{P(C₆H₅)₃]₂Ag(SC{O}C₆H₅)₂Ga(SC{O}C₆H₅)₂], and
[{P(C₆H₅)₃]₂Ag(SC{O}CH₃)₂Ga(SC{O}CH₃)₂].

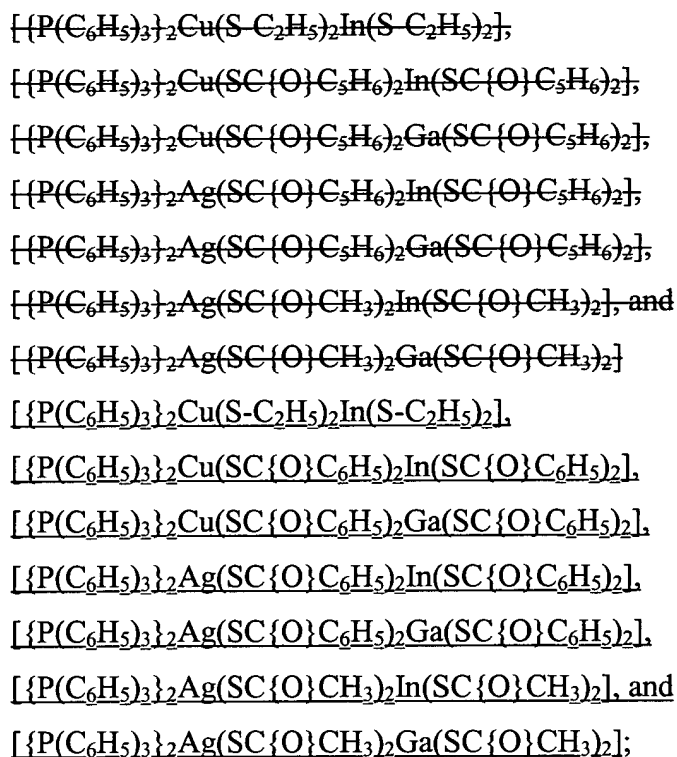
38. (original) A single source precursor for the deposition of ternary chalcopyrite materials, said single source precursor being a liquid at room temperature and being effective to yield a ternary chalcopyrite material upon heating or pyrolysis thereof.

39. (original) A single source precursor according to claim 38, said single source precursor being effective to yield a I-III-VI₂ ternary chalcopyrite material upon heating or pyrolysis of said single source precursor at a temperature less than about 500°C.

40. (currently amended) A method of depositing ternary chalcopyrite materials comprising the steps of:

a) providing a first single source precursor for said ternary chalcopyrite material, said first single source precursor having the empirical formula $[\{L\}_n M' (ER)_x (X)_y (R)_z M'']$, wherein x is 1-4, x+y+z=4, n is greater than or equal to 1, L is a Lewis base that is coordinated to M' via a dative bond, M' is a Group I-B atom, M'' is a Group III-A atom, E is a Group VI-A atom, X is a Group VII-A atom, and each R is individually selected from the group consisting of alkyl, aryl,

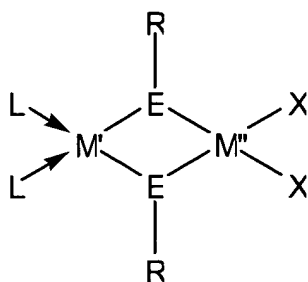
vinyl, perfluoro alkyl, perfluoro aryl, silane, and carbamato groups, said single source precursor excluding



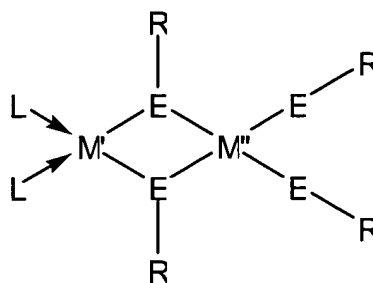
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b) depositing the single source precursor on a substrate using a spray CVD technique.

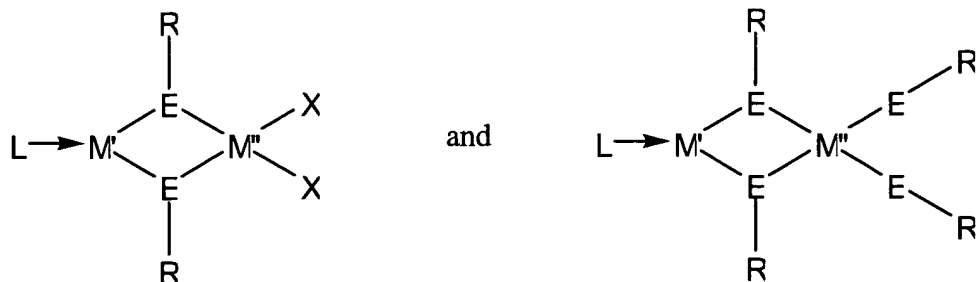
41. (original) A method according to claim 40, said single source precursor having a structural formula selected from the group consisting of



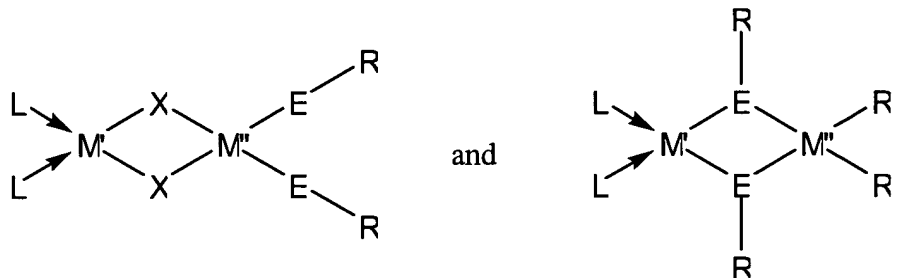
and



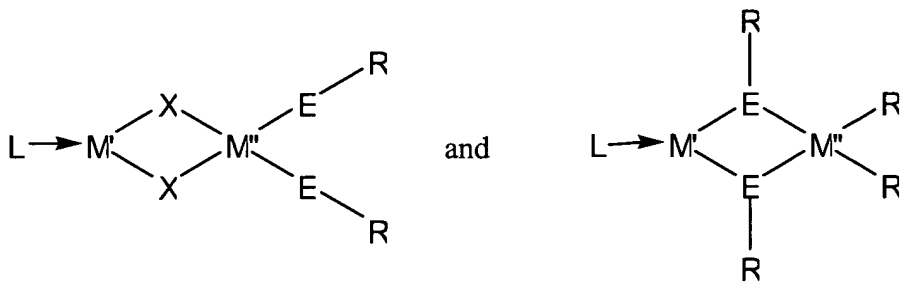
42. (original) A method according to claim 40, said single source precursor having a structural formula selected from the group consisting of



43. (original) A method according to claim 40, said single source precursor having a structural formula selected from the group consisting of



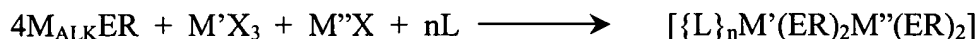
44. (original) A method according to claim 40, said single source precursor having a structural formula selected from the group consisting of



45. (original) A method according to claim 40, said single source precursor having three E-R groups.

46. (original) A method according to claim 40, comprising the steps of providing a second single source precursor, and applying said first and second single source precursors on said substrate via said spray CVD technique.

47. (currently amended) A method of making a single source precursor for the deposition of ternary chalcopyrite materials comprising the step of carrying out the following reaction:



wherein

M_{ALK} is an alkali metal element,

E is a Group VI-A element,

R is selected from the group consisting of alkyl, aryl, vinyl, perfluoro alkyl, perfluoro aryl, silane and carbamato groups,

M' is a Group [[III-A]] I-B element,

M'' is a Group [[I-B]] III-A element,

X is a Group VII-A element, and

n is greater than or equal to 1.

48. (original) A method according to claim 47, wherein said single source precursor is made in a single step consisting essentially of said reaction.

49. (original) A method according to claim 47, wherein the ionic complex $[\text{L}_{(n)}\text{M}''(\text{CH}_3\text{CN})_{(4-n)}]^+$ is formed *in situ* as said reaction proceeds.

50. (original) A method according to claim 47, said reaction being carried out under anaerobic conditions.

51. (original) A method according to claim 47, said reaction being carried out under non-anaerobic conditions.

52. (original) A method of making a quantum dot comprising the steps of:
a) providing a single source precursor for a ternary chalcopyrite material; and
b) pyrolyzing said single source precursor to yield a quantum dot made of ternary chalcopyrite material having dimensions less than 100 nanometers.

53. (original) A method according to claim 52, said quantum dot made of a ternary I-III-VI₂ chalcopyrite material.

54. (original) A method according to claim 52, said quantum dot made of a ternary I-III₅-VI₈ chalcopyrite material.

55. (original) A method according to claim 52, said pyrolyzing step being carried out at a temperature less than about 500°C.

56. (original) A method according to claim 52, said single source precursor having the empirical formula $[\{L\}_n M'(ER)_x(X)_y(R)_z M'']$, wherein x is 1-4, $x+y+z=4$, n is greater than or equal to 1, L is a Lewis base that is coordinated to M' via a dative bond, M' is a Group I-B atom, M'' is a Group III-A atom, E is a Group VI-A atom, X is a Group VII-A atom, and each R is individually selected from the group consisting of alkyl, aryl, vinyl, perfluoro alkyl, perfluoro aryl, silane, and carbamato groups.

57. (original) A single source precursor according to claim 2, said single source precursor being effective to yield a I-III₅-VI₈ ternary chalcopyrite material upon heating or pyrolysis of said single source precursor.

58. (original) A single source precursor according to claim 30, said single source precursor being effective to yield a ternary chalcopyrite material having a band gap of 0.5-3.5 eV between a conduction band and a valence band thereof, said ternary chalcopyrite material being (Cu:Ag:Au)₁(Al:In:Ga)₁(S:Se:Te)₂.

59. (new) A single source precursor according to claim 2, said Group VI-A atom being selected from the group consisting of S, Se and Te.

60. (new) A single source precursor according to claim 16, said Group VI-A atom being selected from the group consisting of S, Se and Te.